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output which is fed to the crystal oscillator **28** to correct the tuning of the crystal oscillator **28** such that the center frequency of the synthesized spin precession signal is precisely at the spin precession frequency of the atomic resonators. In this manner, the frequency standard outputs are frequency or phase locked to the atomic resonators.

The Pockels cell **16**, in combination with the circular polarizer **27**, provides an especially desirable beam intensity modulator as it readily permits operation at modulation frequencies in the gHz. region which modulation is very difficult to obtain by other means.

Although the beam modulator **16** has been described as operating at the field independent hyperfine resonant frequency, in an alternative embodiment, the beam modulator **16** is operated at a neoharmonic of the hyperfine resonance frequency.

Referring now to FIGS. 8 and 9, there are shown Pockels cell circuits for use at high microwave frequencies such as the 2 to 20 gHz. range. More particularly, in FIG. 8 the Pockels cell crystal **17** is of the type which permits the modulating electric field to be applied transversely to the optical beam path **3**. The crystal is positioned in the gap of a re-entrant toroidal cavity resonator **31**. Beam holes **32** are provided in the opposite side walls of the cavity resonator **31** for passage of the beam therethrough. Tubes **33** of transverse dimensions below cut off at the spin precession frequency ω are aligned with the beam path **3** to prevent loading of the cavity **31** by the beam holes **32**. An input coupling loop **34** serves as means for coupling the synthesized modulation signal ω into the cavity **31**. The cavity **31** is tuned to the modulation frequency ω.

In FIG. 9, the Pockels cell crystal **17** is of the type wherein the modulating field is applied in a direction parallel to the optical beam path **3**. The beam holes **35** are positioned in opposed re-entrant portions of the cavity **31**. Tubes **33** are aligned with the beam path **3** and are below cut off to prevent loading of the cavity resonator **31**.

The schematic circuit diagrams used herein have been simplified for sake of explanation. Specifically the various optical pumping schemes and devices are not depicted in detail as such devices are deemed well known. For example, optical pumping of Rb vapor typically employs a hyperfine Rb 85 filter cell and pumping of He typically employs means for exciting an electron discharge inside the gas cell **1**.

What is claimed is:

1. An atomic resonant apparatus including, means forming a system of atomic resonators, means for producing a beam of optical radiation of a wavelength to produce optical pumping of the system of atomic resonators, means for modulating the sense of rotational polarization of the beam of optical pumping radiation and applying the modulated radiation to said system of atomic resonators, the frequency of the modulation of the applied radiation being of a certain frequency to produce spin precession of the atomic resonators, and means for detecting spin precession of the atomic resonators.

2. The apparatus of claim **1** wherein said means for detecting spin precession of the atomic resonators produces an output signal at the spin precession frequency, and means forming a feedback path for feeding the detected spin precession signal to said rotational polarization modulator means for modulating the beam of applied optical radiation at the spin precession frequency to produce self-sustained precession of the atomic resonant system.

3. The apparatus of claim **1** wherein the spin precessions of the atomic resonators are magnetic field dependent spin precessions.

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4. The apparatus of claim 1 wherein the spin precessions of the atomic resonators are magnetic field independent hyperfine spin precessions.

5. The apparatus of claim 4 including means forming a rotational polarizer having only one sense of polarization disposed in the path of modulated optical pumping radiation between said rotational polarization modulator means and said system of atomic resonators for converting the polarization modulation of the optical radiation to intensity modulation to produce intensity modulation of the applied radiation at the certain modulation frequency.

6. The apparatus of claim 2 wherein said means for detecting the spin precessions and producing an output at the spin precession frequency includes a photo sensitive detector responsive to the optical pumping radiation which has passed through said spin precessing atomic resonators.

7. The apparatus of claim 1 including means for modulating the spin precessions of said atomic resonators at a second frequency substantially lower than the spin precession frequency, means for detecting the lower frequency modulation of the spin precessions, and means responsive to the detected lower frequency modulation components for maintaining the higher frequency of the optical pumping modulation at the correct center frequency to produce spin precession of the atomic resonators.

8. The apparatus of claim 7 wherein the atomic resonant apparatus is a frequency standard and the spin precessions are at a magnetic field independent hyperfine resonance frequency of the atomic resonators, and including means for deriving an output frequency for the frequency standard which is stabilized by means of signals derived from the field independent hyperfine spin precessions of the atomic resonators.

9. A method of producing spin precessions of a system of atomic resonators comprising the steps of irradiating the atomic resonators with rotationally polarized optical pumping radiation, modulating the sense of rotational polarization of the applied optical pumping radiation at a certain frequency to produce spin precessions of the atomic resonators, detecting spin precession of the system of atomic resonators, and maintaining the intensity of the modulated applied optical pumping radiation substantially constant at the certain modulation frequency.

10. The method of claim 9 including the steps of detecting the optical pumping radiation which has passed through the said system of atomic resonators.

11. The method of claim 9 wherein the optical pumping radiation is applied in the form of a beam which is directed at a substantial angle to a unidirectional magnetic field within the system of atomic resonators.

12. The apparatus of claim 1 wherein said rotational polarization modulator means is a Pockels cell.

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U.S. Cl. X.R.

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